3.0 COMMENTS ON THE LIMITED CALPUFF EVALUATION

The EPA report relies upon a set of limited CALPUFF evaluations conducted by the NDDH to determine that the selection of technical options is appropriate. The most recent NDDH study used hourly emission rates from the major SO_2 sources and annual average emissions from the sources without hourly emissions data, such as the oil and gas sources. These emission inputs were paired with concurrent meteorological data for the year 2000. The CALPUFF predictions were compared to observations available at two SO_2 monitors located at Dunn Center and in the Theodore Roosevelt National Park, South Unit (unfortunately, the monitor in the TRNP North Unit was shut down in 1998). The locations of these monitors relative to the major SO_2 sources are shown in Figure 3-1. The resulting ranked concentrations unpaired in time but paired in space are shown in Figures 3-2 and 3-3 for Dunn Center (3-hour and 24-hour averages, respectively) and Figures 3-4 and 3-5 for TRNP, South Unit. The central diagonal line in each figure denotes a "perfect" model prediction for the line between the lower left and upper right corners. The other diagonal lines above and below the central diagonal line denote factor of two over prediction (the line above) and under prediction (the line below).

In general, the procedures used by the NDDH in their most recent study corrected deficiencies in the earlier study reported in 1999, which did not use hourly emission rates from the major sources. In addition, the emissions data in 2000 used a more accurate flow measurement technique that avoided overestimates of stack emissions associated with methods used prior to 2000.

The NDDH limited evaluation study conducted for the year 2000 can be further improved as noted below:

- Numerous oil and gas production sources beyond 50 kilometers from the monitors were not modeled. Their omission is accounted for in the estimate of regional background, discussed below.

- The monitors are both of the pulsed fluorescent type, with a threshold detection level of 2 parts per billion (ppb). Reported zero observed values were adjusted to half the threshold value (1 ppb) in the model evaluation study. However, zero predicted values were not similarly adjusted, leading to a potential underestimate of the predicted values.

- The EPA's Guideline on Air Quality Modeling (Appendix W of 40 CFR Part 51) states in Section 9.2 that the total predicted value should include a regional background value to account for natural background and unmodeled sources. In the evaluation study, the NDDH failed to follow this important step. In order to correct this omission, we have reviewed the evaluation procedures and the TRNP South Unit monitoring data for days with winds from a southerly direction, for which there are no upwind major SO_2 sources. We have also noted that the NDDH adjusted the observed zero values upward, but not the predicted zero values.

- The monitored values for days with southerly winds support a regional background value of at least 1 ppb. For the critical easterly wind cases with more population centers and more oil and gas sources, a regional background of 1.5 ppb (about 4 $\mu g/m^3$, and still below the instrument detection threshold) is reasonable. This value is still very low and is much lower than values typically used as regional background estimates in other rural states

(e.g., the Alabama Department of Environmental Management (2000) uses a background concentration of 10 $\mu g/m^3$).

When a regional background of 4 $\mu g/m^3$ is added to the model predictions, the plots of the model evaluation results change significantly from the figures shown above, as seen in Figures 3-6 and 3-7 for the Dunn Center monitor and Figures 3-8 and 3-9 for the TRNP South Unit monitor. The EPA concern about model underpredictions is no longer valid (EPA's concerns were misplaced because the under prediction magnitude was at most only about 1 $\mu g/m^3$, well below the instrument threshold). The new results indicate that for Dunn Center (roughly 100 km from many of the major sources), CALPUFF over predicts on average by roughly 50% for the top several concentrations. For TRNP South Unit (roughly 150-200 km from many of the major sources), the CALPUFF over prediction tendency for the peak 3-hour concentrations is nearly 2.0, and it slightly exceeds 2.0 for the highest 24-hour averages.

These modified model evaluation results are consistent with the IWAQM Phase 2 report findings that warned of a CALPUFF model over prediction at the distances being considered for this modeling application. With corroboration from this limited evaluation study, the EPA modeling results are therefore likely to be subject to the same over prediction problem, and the findings from the EPA study must be viewed with these over prediction tendencies in mind. Either the EPA modeling procedures need to be corrected to eliminate the over prediction tendency, or the results need to be adjusted to account for the over prediction tendency.

Figure 3-1 **Map Showing Two SO_2 Monitoring Sites (Dunn Center and TRNP South Unit) and 12 Major SO_2 Sources. [1 = Coal Creek; 2 = Antelope Valley/Great Plain Synfuels; 3 = Coyote; 4 = Leland Olds/Stanton; 5 = Milton R Young; 6 = Heskett/Mandan Refinery ; 7 = Little Knife Gas; 8 = Grasslands Gas; 9 = Tioga Gas; 10 = Lignite Gas; 11 = Colstrip; 12 = CELP Boiler]**

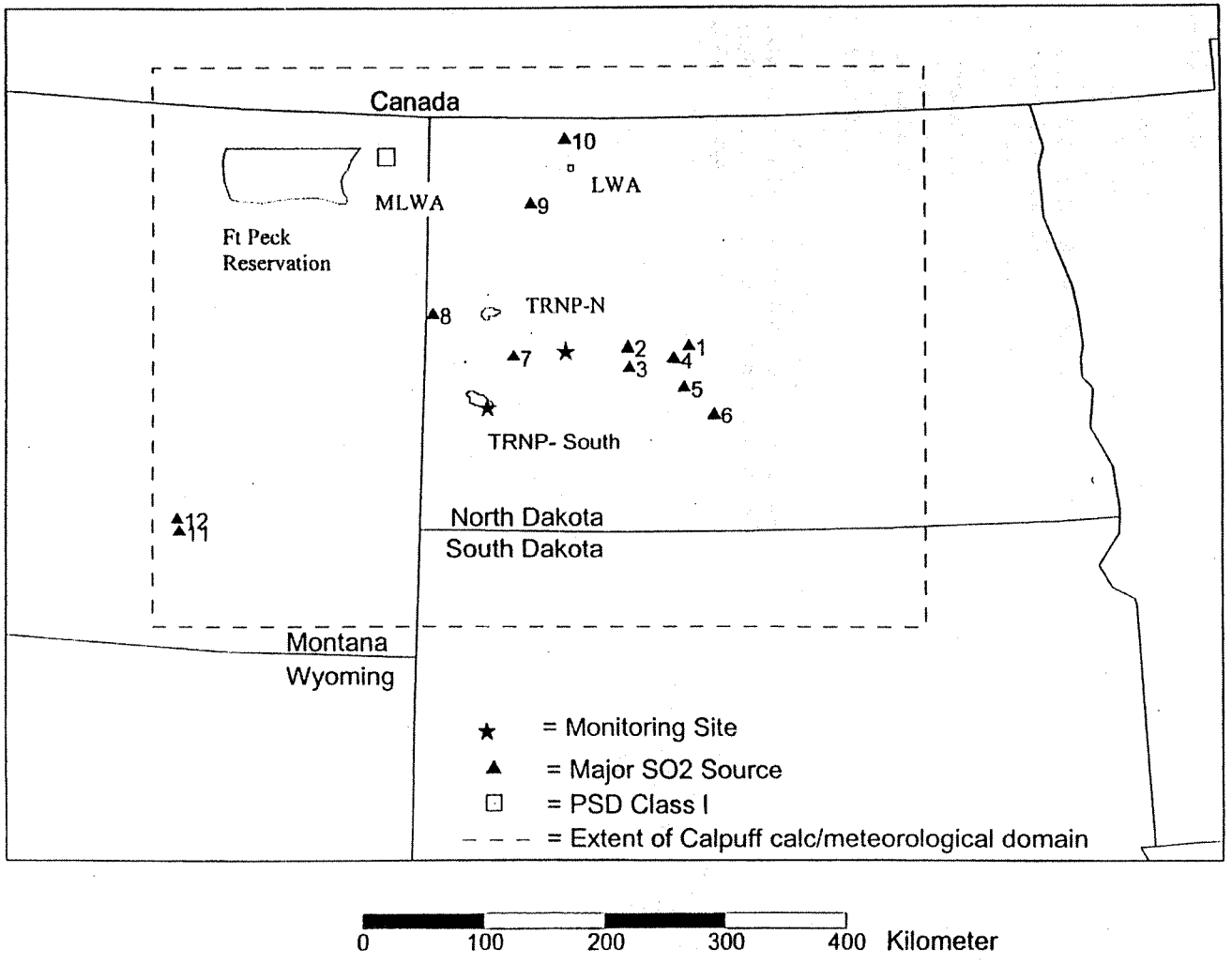


Figure 3-2 NDDH plot of CALPUFF Model Performance for Year 2000 (3-hour averages at Dunn Center)

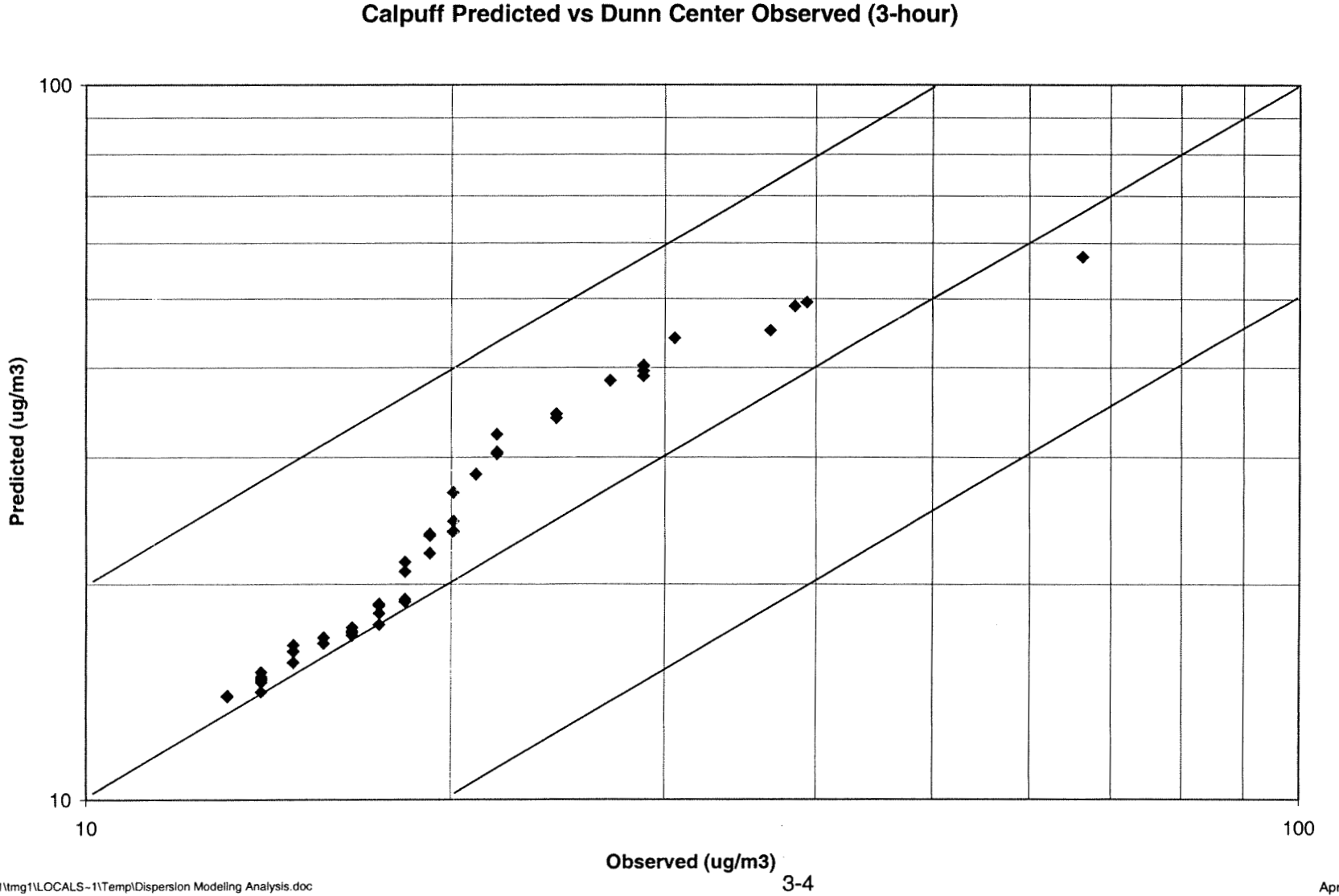


Figure 3-3 NDDH plot of CALPUFF Model Performance for Year 2000 (24-hour averages at Dunn Center)

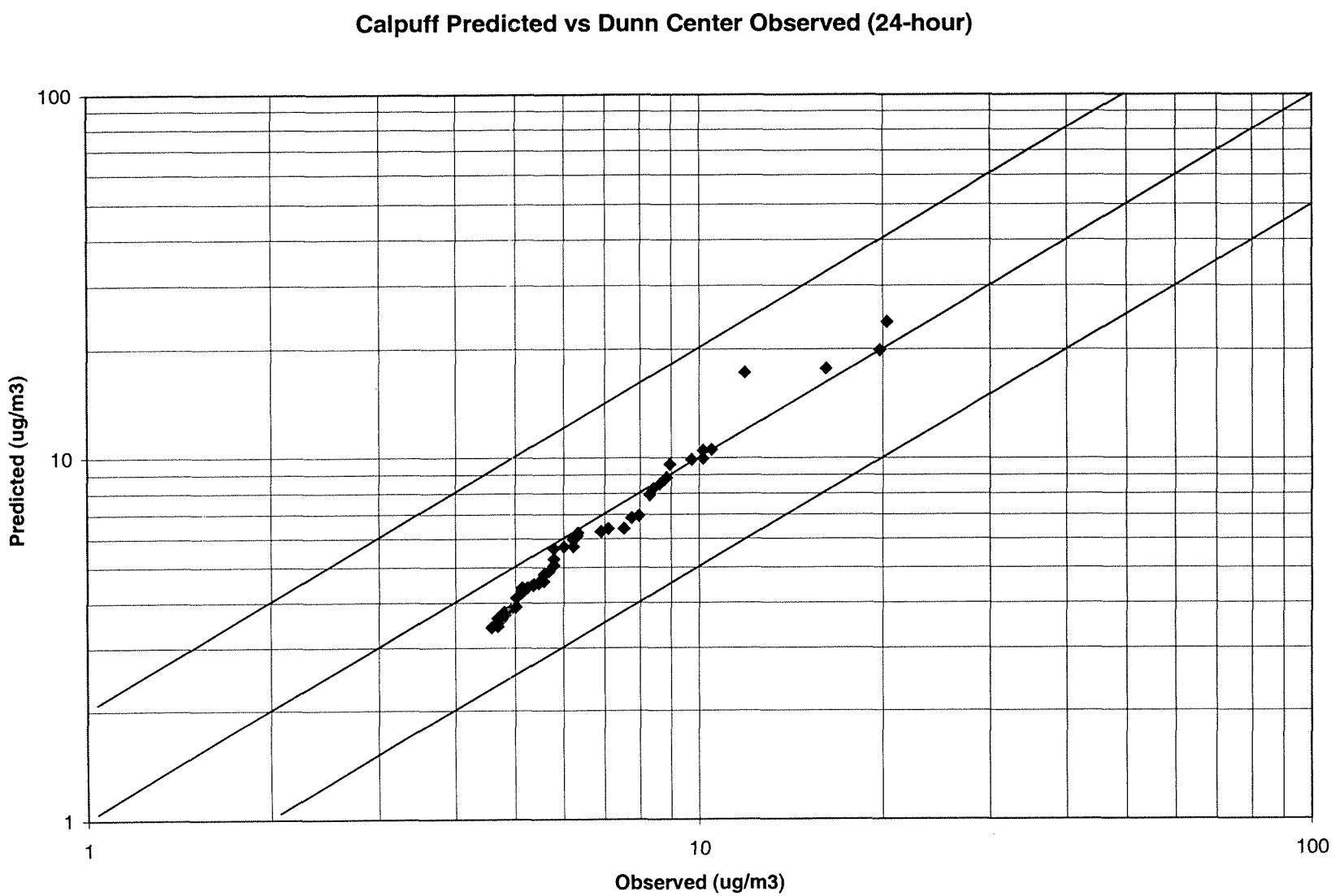


Figure 3-4 NDDH plot of CALPUFF Model Performance for Year 2000 (3-hour averages at TRNP South Unit)

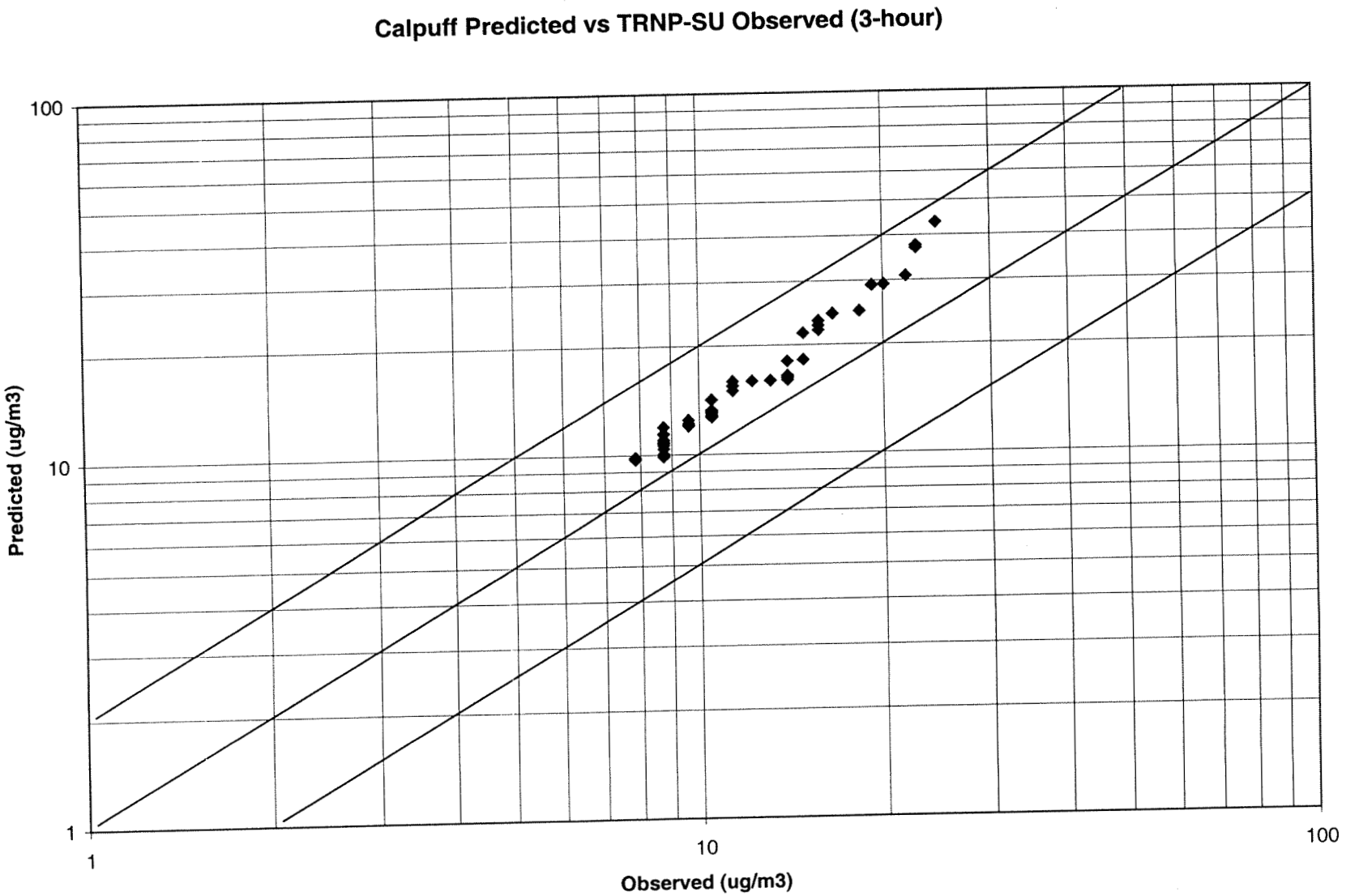


Figure 3-5 NDDH plot of CALPUFF Model Performance for Year 2000 (24-hour averages at TRNP South Unit)

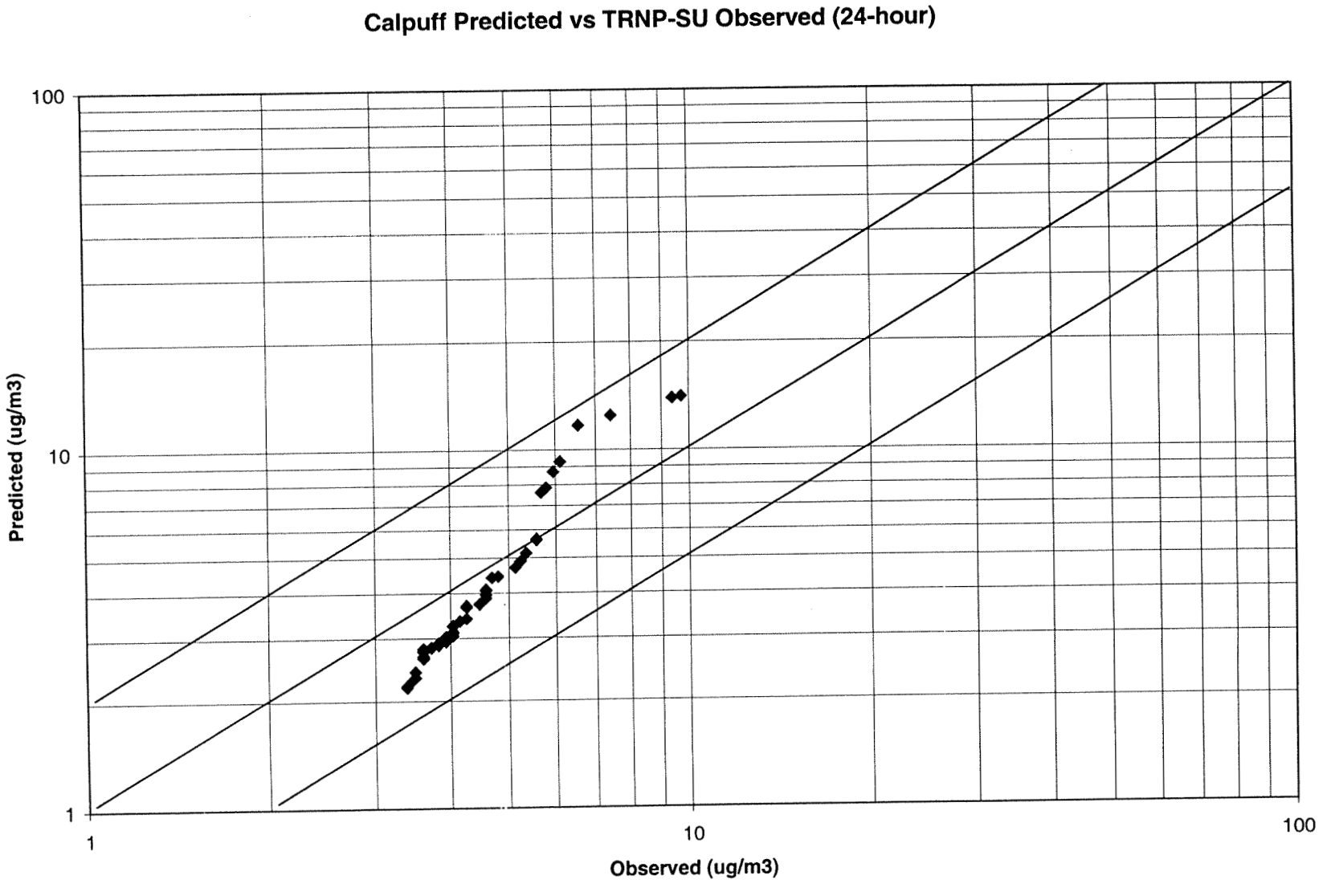


Figure 3-6 **Modified plot of CALPUFF Model Performance for Year 2000 (3-hour averages at Dunn Center)**

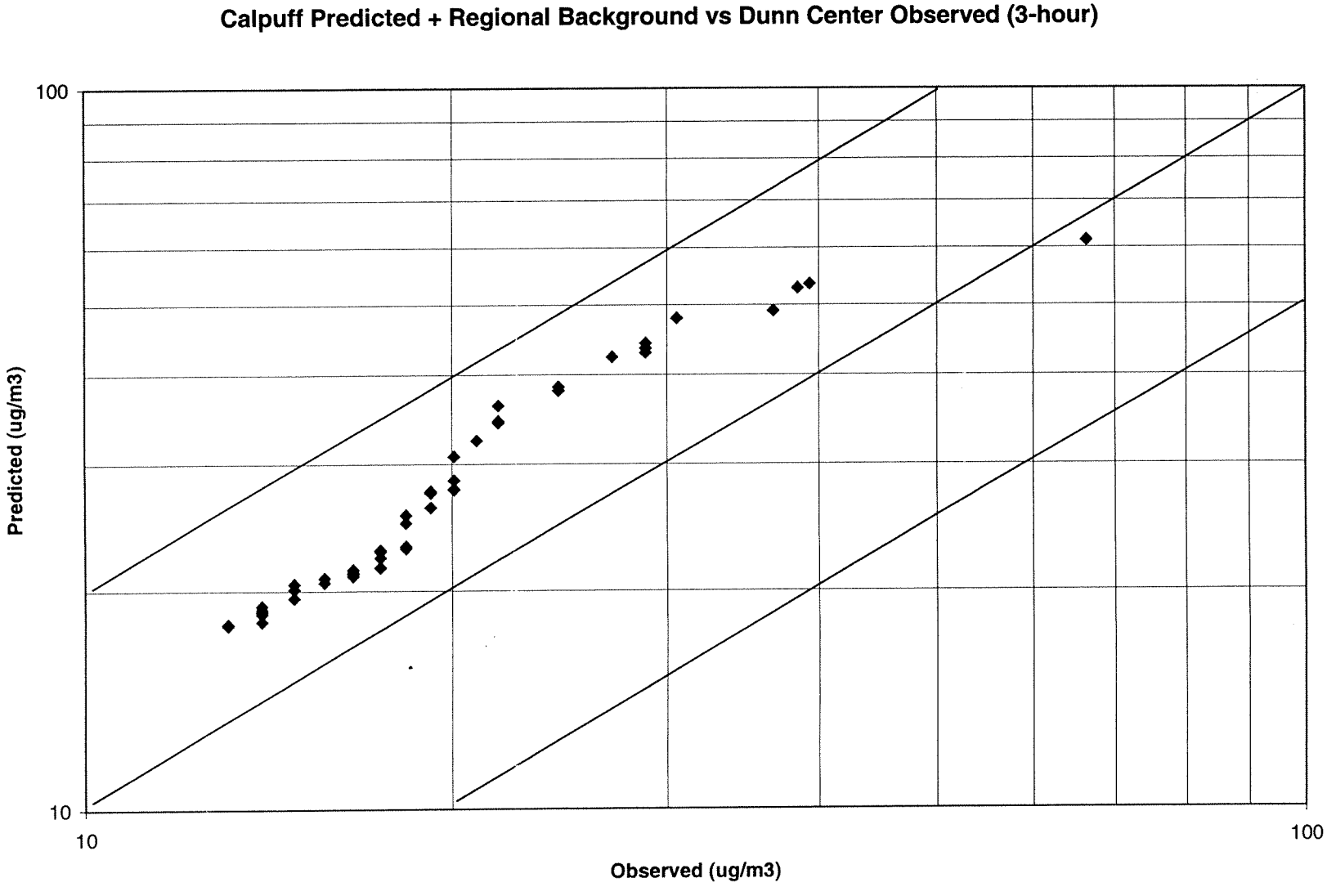


Figure 3-7 Modified plot of CALPUFF Model Performance for Year 2000 (24-hour averages at Dunn Center)

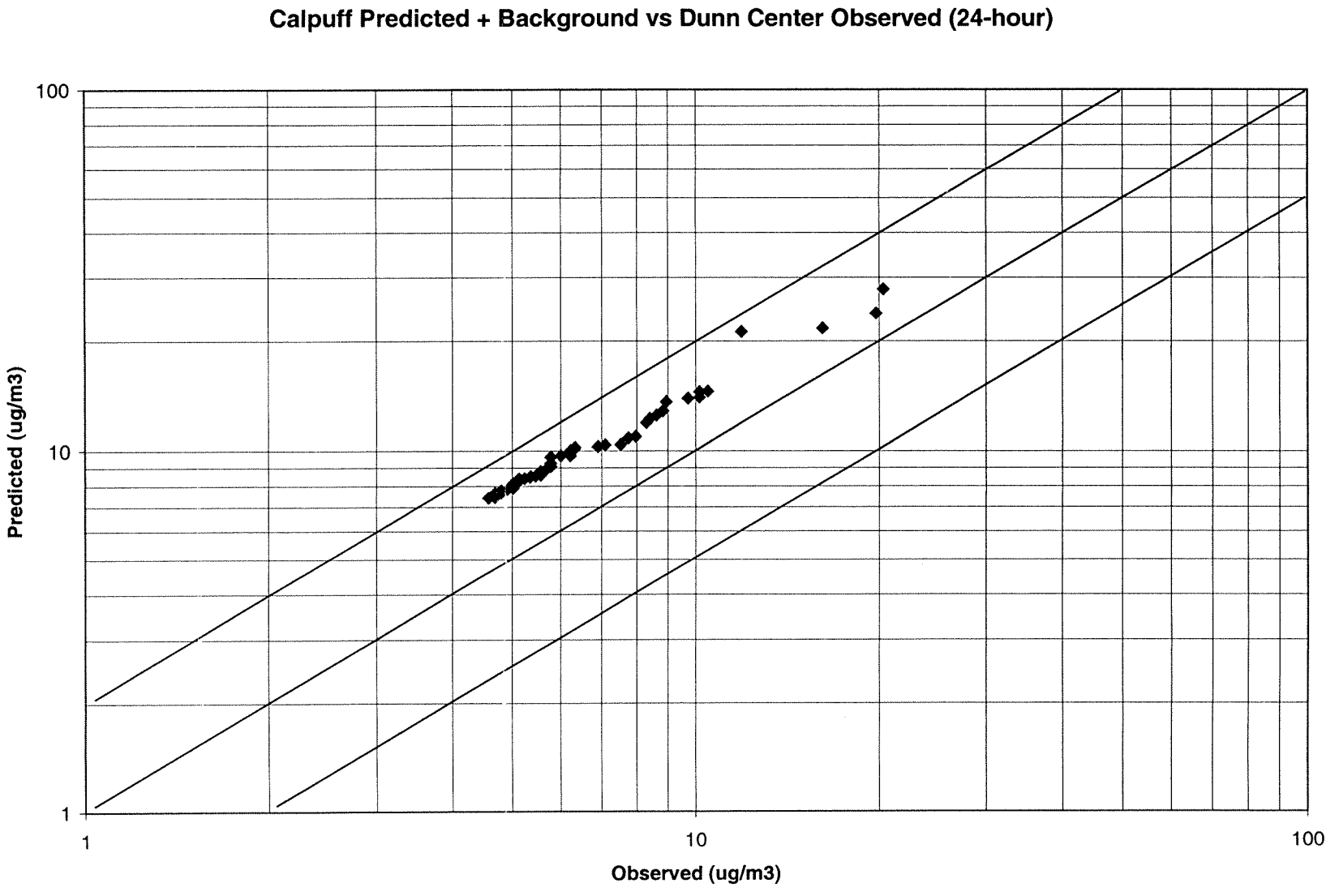


Figure 3-8 **Modified plot of CALPUFF Model Performance for Year 2000 (3-hour averages at TRNP South Unit)**

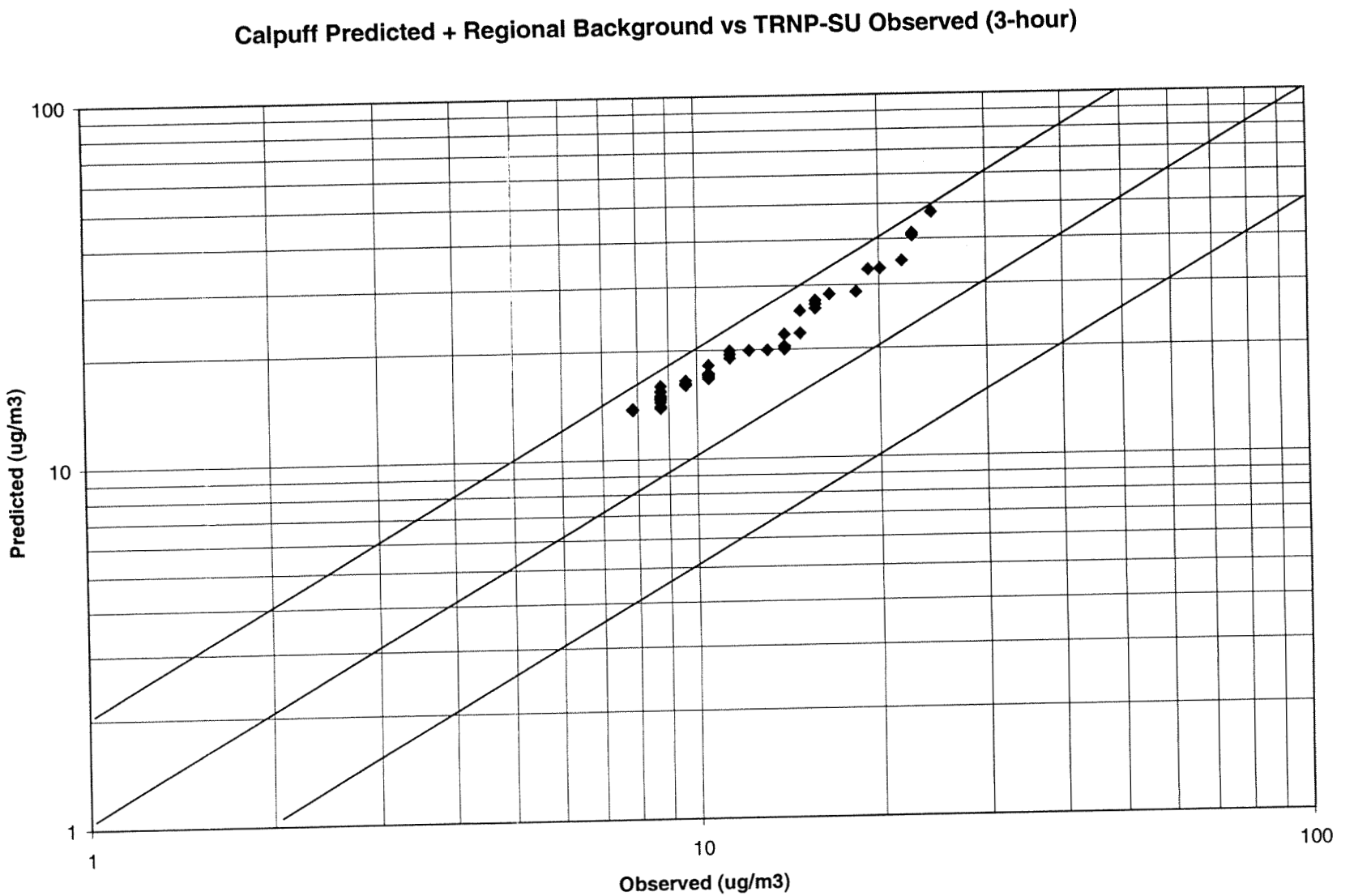
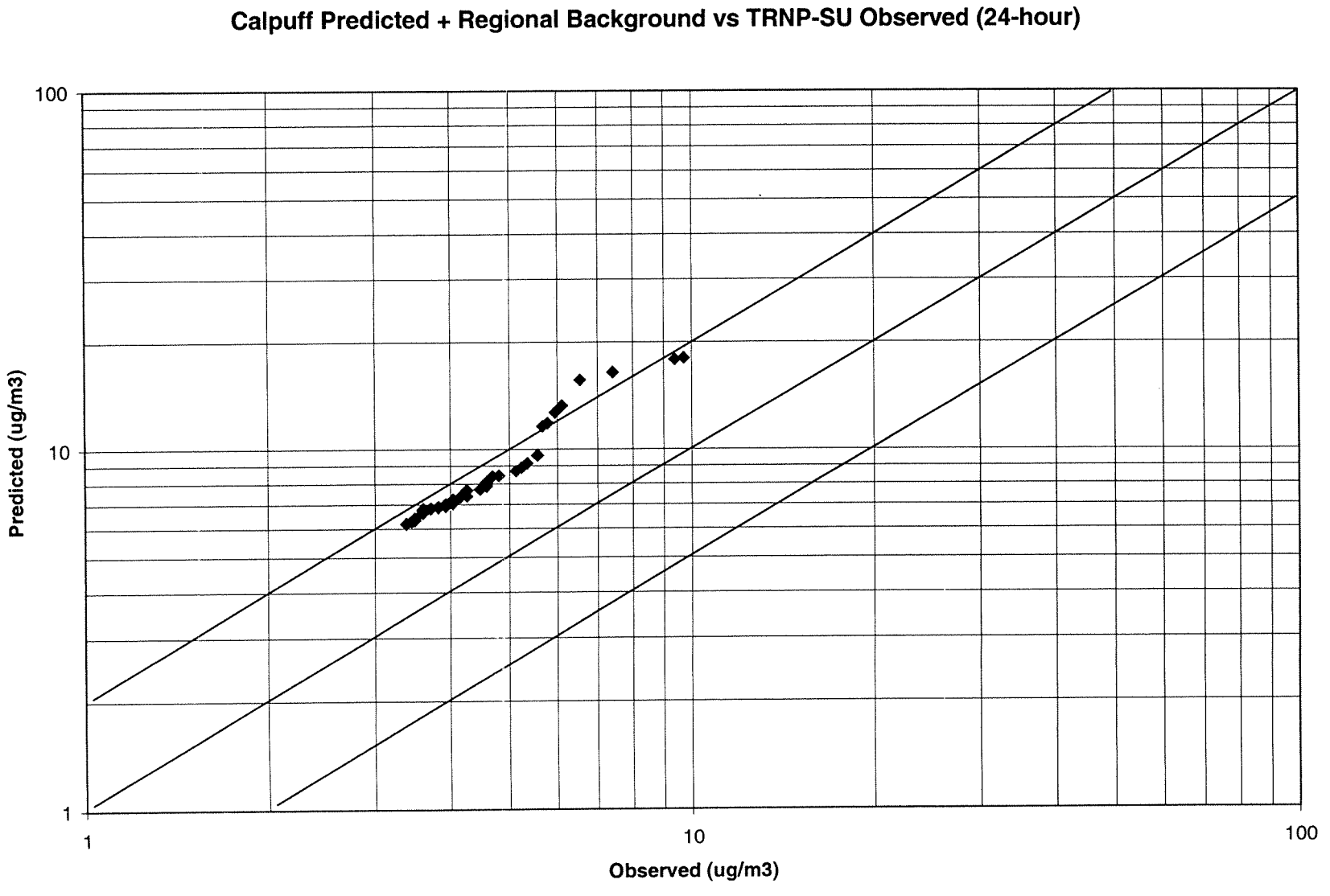


Figure 3-9 **Modified plot of CALPUFF Model Performance for Year 2000 (24-hour averages at TRNP South Unit)**



4.0 MEASURED CONCENTRATION TRENDS

4.1 TRENDS OF MEASURED SO_2 CONCENTRATIONS

Monitors for SO_2 have been maintained in the Theodore Roosevelt National Park (TRNP), South Unit and North Unit, since the early 1980s. This covers virtually all of the period since the PSD baseline date was established for the North Dakota PSD Class I areas. If it were true that the PSD increment has been totally consumed, then this feature should show up in the monitoring data as an increase in the second-highest concentrations over time to the present day.

Figures 4-1 and 4-2 show the trends of the 3-hour and 24-hour highest, second highest measurements at the TRNP North Unit, while Figures 4-3 and 4-4 provide the trends at the TRNP South Unit monitor. It is clear from the figures that the recent SO_2 measurements are among the lowest in the past 20 years. This is evidence that the air quality in the PSD Class I areas associated with the highest modeled results has not degraded, and has actually improved. Therefore, the model emission inventory must be missing some key PSD increment expanding sources that would lead to this result. More discussion of this issue is provided in Section 4-2.

4.2 PSD EMISSIONS INVENTORY

The EPA report states that the air quality in the PSD Class I areas is only slightly affected by the nearby oil and gas sources. However, the proximity of these sources to the Class I areas creates considerable doubt as to the validity of that assumption, particularly in light of the monitoring trends shown in Section 4.1. If the observed concentrations of SO_2 are not increasing in the PSD Class I areas (an observation which has led to permit variances granted in the past), then it does not make sense that modeling results show an increment violation. The CALPUFF predictions within each Class I area from the distant sources are relatively uniform, given the small sizes of the parks in relation to the distances involved from the major SO_2 sources. The concentration trend is consistent between the TRNP North and South Unit monitors. *The only explanation for this inconsistency is that some PSD increment expansion sources are not being accounted for in the modeling.*

Where are these PSD increment expansion sources, and when did they operate? The answer may lie with the nearby oil and gas producing sources that EPA has not yet considered. It is likely that in the 1970s, the lack of available gas pipelines caused these sources to continuously flare gas streams that could not otherwise be marketed. Later on, the construction of gas pipelines allowed the gas streams to be marketed, and the flaring operations closed down. These flare emissions, plus other emissions associated with the numerous nearby oil and gas sources, should be accounted for in the modeling as accurately and completely as possible.

Another important increment expanding source is the Royal Oak briquette factory near Dickinson. This source was only about 50 kilometers from the TRNP South Unit and it was a major SO_2 source. It is noteworthy that in its updated assessment of baseline source emissions, the NDDH has more than tripled the SO_2 emission rate from Royal Oak, from about 69 to 222 grams per second. It is also noteworthy that during the maximum coal usage period of this facility (during the 1980s), the observed SO_2 concentrations at the TRNP South and North Unit monitors registered their highest concentrations, as shown in Figures 4-1 through 4-4. The coincidence of these emissions and the corresponding monitored peaks is worthy of further investigation.

In summary, EPA needs to more thoroughly review the baseline emissions so that they can account for the overall decrease in measured SO_2 concentrations over the past 20+ years. Until this step is accomplished, the EPA study cannot be considered as being satisfactorily completed or credible.

Figure 4-1 **Monitored SO_2 Values – TRNP-NU 3-hour 2nd High**

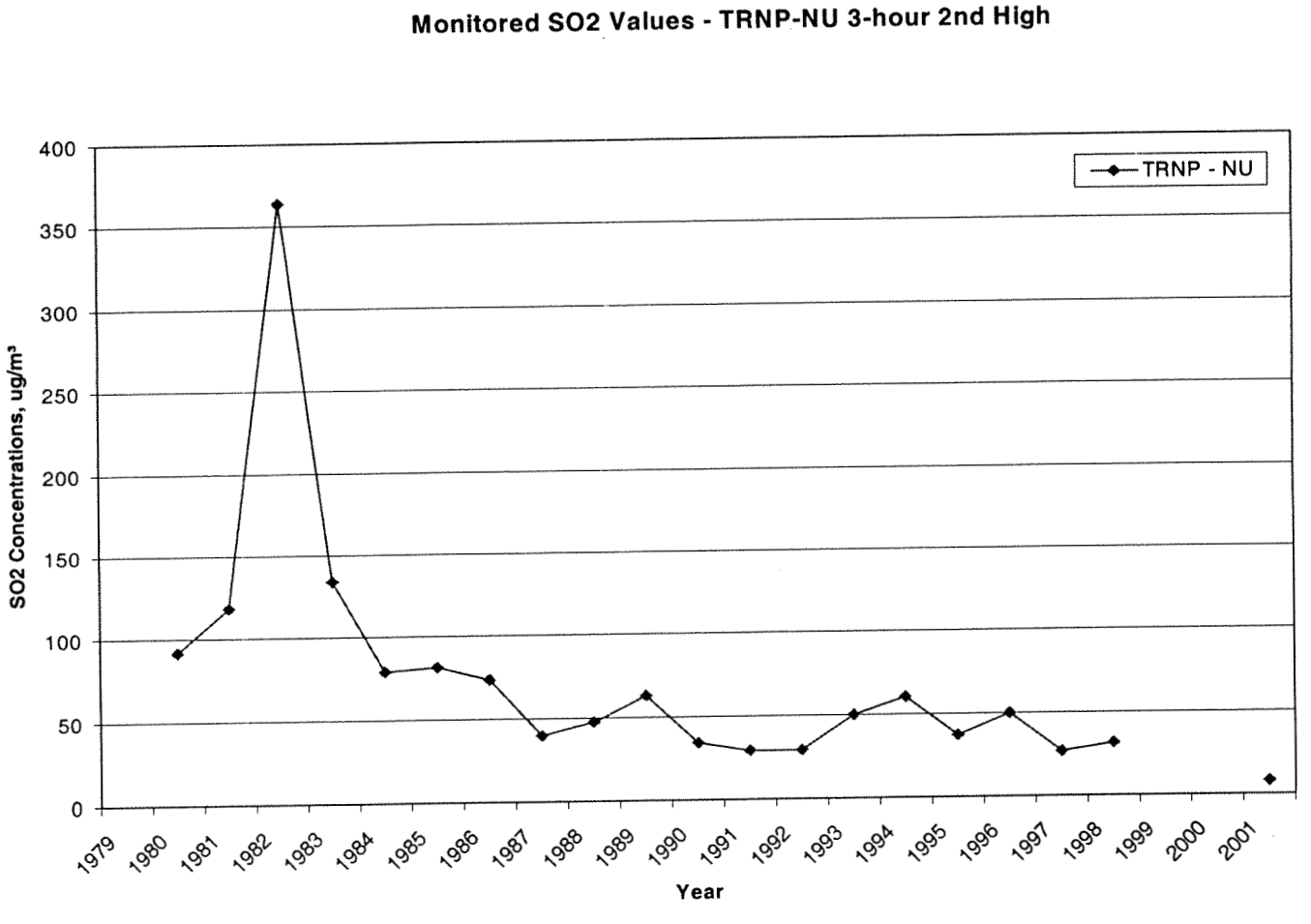


Figure 4-2 Monitored SO_2 Values – TRNP-NU 24-hour 2nd High

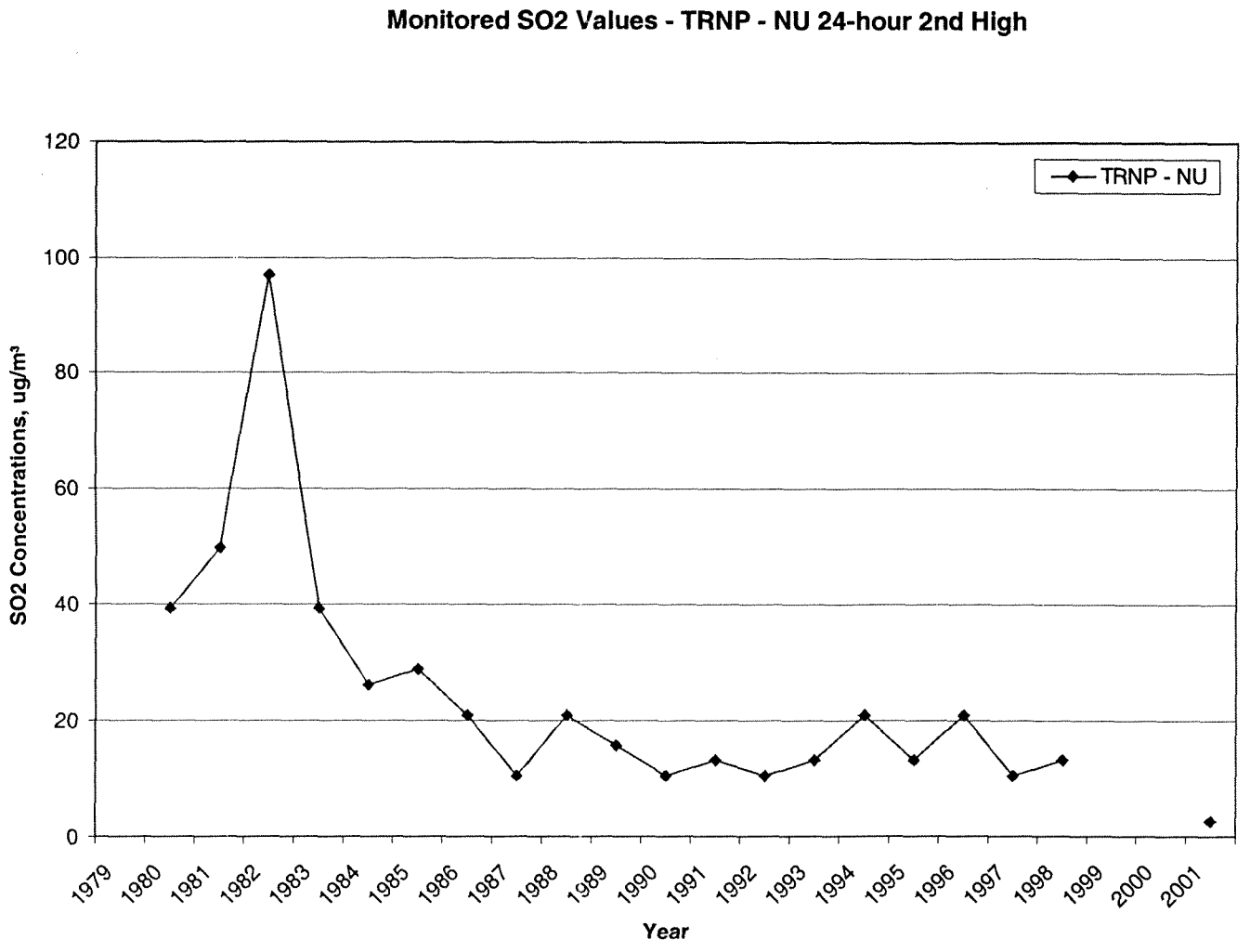


Figure 4-3 **Monitored SO_2 Values – TRNP-SU 3-hour 2nd High**

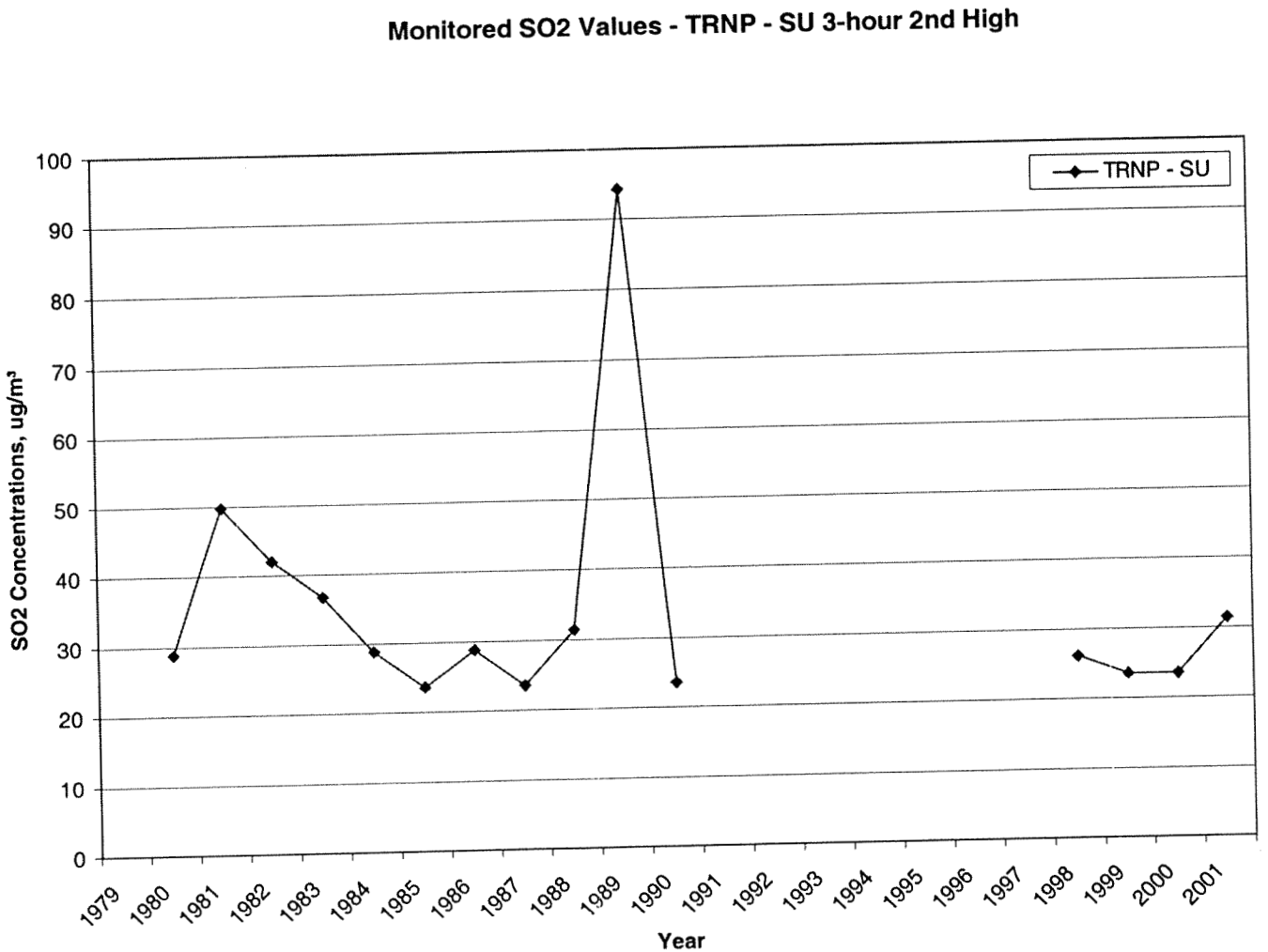
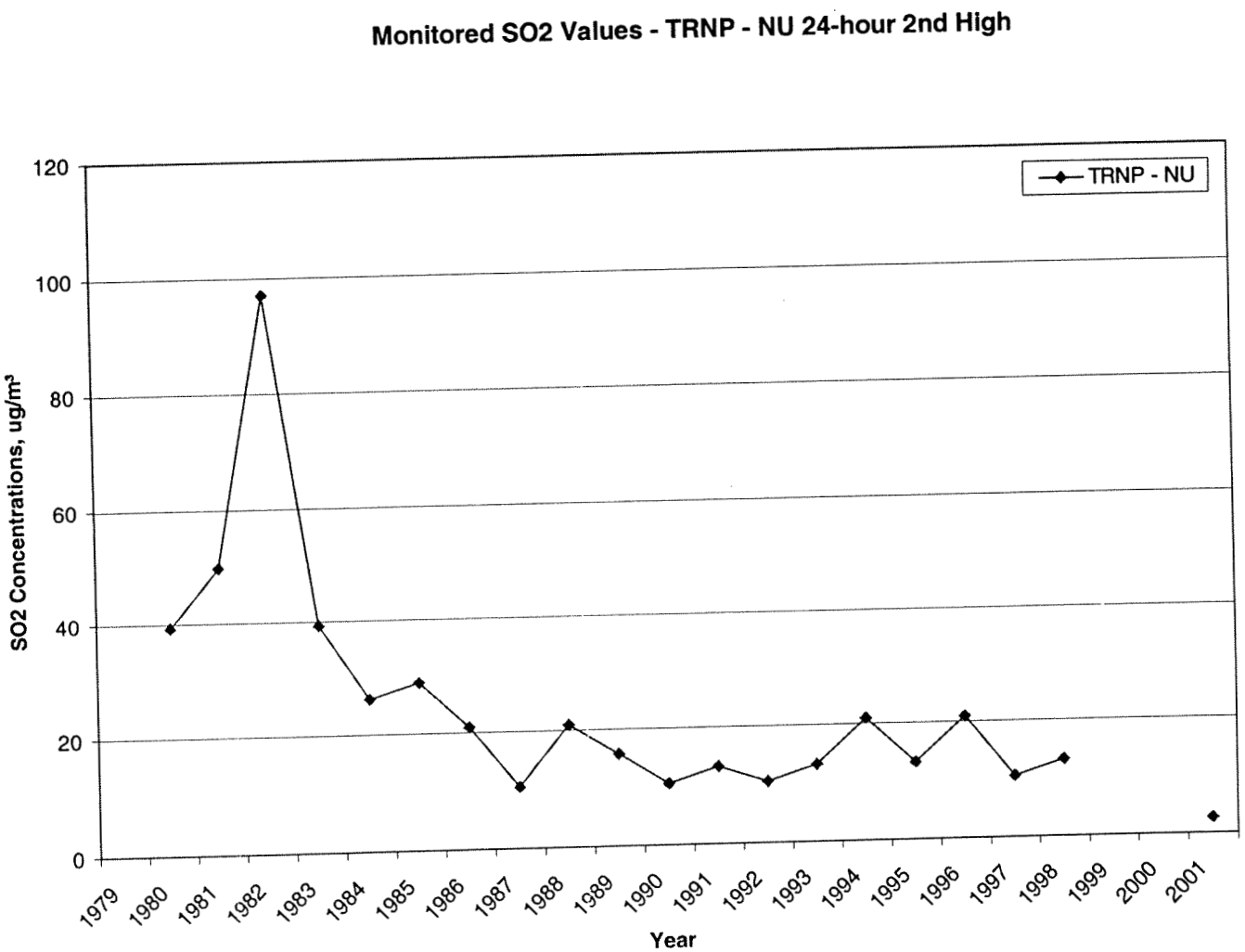


Figure 4-4 Monitored SO_2 Values – TRNP-NU 24-hour 2nd High



5.0 CONCLUSIONS

The major comments that are provided in this document are summarized below.

- While the CALPUFF model is an advancement over previous techniques for long-range transport modeling, the model still has significant limitations. At the distances being considered between the major sources and PSD Class I receptors, CALPUFF would be expected to over predict by about a factor of 2, based upon results from independent studies.

- The NDDH CALPUFF evaluation for the year 2000 neglected to consider regional background concentration contributions to the full predicted concentration. When a low regional background value of 4 μg/m3 is accounted for, the evaluation results show an over prediction tendency of about a factor of 2, in agreement with the studies reported by IWAQM.

- Monitoring data in the TRNP North and South Units provides evidence that the SO_2 concentrations have, if anything, dropped over the past 20 years. The modeling should indicate a similar trend. Since it does not, the only explanation is that some PSD increment expanding sources have not yet been accounted for. Possible baseline emission contributors to the past high observed SO_2 concentrations are flares at numerous oil and gas wells and the Royal Oak briquette plant. Since these past sources were much closer to the affected PSD Class I areas than most of the major SO_2 increment consuming sources assessed in this study, these emission reductions could account for the observed improvement in air quality within the PSD Class I areas.

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